traced back to a fundamental property of protoplasm, and, like the capacity to vary, this property becomes more and more limited with advanced differentiation until, in the highest types of animals, the power of regeneration is much more reduced than in lower forms. This power, he thinks, still remains in the germ plasm which in higher animals becomes more and more localized in specific organs while in plants and in lower animals it is still present in part, at least, in all somatic cells, making them what Driesch calls "equipotential." Not only in different animal types does this somatic and germinal distinction exist, but among the different cells of the same individual as well, the difference being measured by their relative power to regenerate, from which it follows that "the regenerative power of a cell-type is a criterion of its differentiation" (p. 44).

The expression "struggle for existence," as used in current theories, he regards as an erroneous phrase for the description of natural phenomena. The conditions throughout all nature, he thinks, indicate a "compromise" of individuals bound by the fundamental law of altruism which is as strikingly operative between varieties, species and races as it is between the various organs, tissues and cells of the individual.

Manche Lebewesen stehen in so enger altruistischer Beziehung zueinander, dass sie bei künstlicher Aufhebung derselben zu Grunde gehen. Bei anderen ist dieser Verhältnis ein viel locheres, ja viele Arten stehen so weit auseinander, dass die altruistischen Beziehungen zwischen ihnen garnicht mehr erkannt werden können. Man kann mit Sicherheit behaupten, dass überall, wo diese Beziehungen enge sind, eine Abhängigkeit in der phylogenetischen Entwicklung bestanden hat. Ganz besonders deutlich tritt das bei Anpassung von Instinkten zweier Tiere in die Erscheinung, z. B. bei der Symbiose des Einsiedlerkrebses und der Aktinie, und man ersieht daraus, dass diese längst anerkannte und auch schon von Darwin hervorgehobene Tatsache sich aus den Erscheinungen des Altruismus ausreichend erklärt (p. 225).

Bearing the title it does, one naturally looks under the heading "Epidemics" for something more akin to pathology than the other chapters present. But a zoologist would have little use for the medical information to be gathered here. The term "epidemic" is used in its broadest sense and not at all with the usual significance. In using it biologically, he differs widely from Osborn and others who have made use of the term in a pathological sense and in connection with disease as one of the factors in the extinction of animals of the past and present. Von Hansemann uses the term to indicate an abnormal or unusual increase of numbers of a race or species of animals; he would not speak of an epidemic of typhoid fever but would describe such a wide-spread illness as due to an epidemic of *Bacillus typhosus*. Great collections of fossils of one type in one geologic bed similarly would be "epidemics." The reason for such epidemics might be unusual abundance of food or unusual absence of adverse environmental conditions, such as absence of enemies or, in a pathological sense, absence of protective agents on the part of the host. Such epidemics, he argues (p. 459), would be another means of increasing varieties and species through variation, since increase in numbers means proportional increase in the number of variants.

The limits of a review do not permit of an enumeration of the hundreds of other interesting points that are brought out with delightful clearness and fairness of presentation. Many of his conclusions are, indeed, open to question, especially such as result from a too superficial view of the problem concerned, but these are due more to ignorance of the great mass of facts involved than to faulty logic. Taken as a whole the book is full of valuable suggestions and is an undoubted contribution to the philosophy of evolution, and as such will be gratefully received.

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*Cave Vertebrates of America—A Study of Degenerative Evolution.* By CARL H. EIGENMANN, Professor of Zoology, Indiana University. 241 pages, 31 full-page plates and 72 text figures. Carnegie Institution of Washington. June, 1909.

Dr. Eigenmann has combined in this one work the results of his various papers on the cave vertebrates of America. The title is slightly misleading, as he includes blind vertebrates which do not inhabit caves. He also includes the results of others who have been interested in the study of blind vertebrates. It is a very comprehensive work dealing with species distributed over the greater part of the United States from the Pacific to the Atlantic and as far south as Cuba, the West Indies and northern portion of South America.

The main bulk of the work is upon the eye as affected by the absence of light. However, he devotes considerable space to morphological, zoological and physiological points of interest in connection with the animals studied. The other special senses were experimented upon and studied in some detail. The embryology of some forms was studied with special reference to the development of the eye.

After a short introduction he devotes considerable space to a general consideration of caves and cave fauna. In this he deals with the relation of caves to the rest of the universe; the environment of caves; the origin and distribution of cave animals; the food supply; the relation of the age of caves to the variety of cave fauna; the tendency to divergence in epigean fishes and convergence in cave forms.

As to the origin of cave fauna, he holds that only those forms which are negatively heliotropic or positively stereotropic are able to adapt themselves to cave life; that species depending on sight for procuring food can not adapt themselves to the environment of the cave. The cave fauna is not the result of accidental entrance of epigean forms. The aquatic cave fauna has developed from those forms adapted to live in dark and secluded places following the stream as it has gradually through ages formed subterranean channels. The non-aquatic forms are of more recent origin and have migrated into the caves after their formation. These are gradually adapting themselves to the more remote parts of the caves.

The author then takes up in detail the blind and cave vertebrates and their eyes. This comprises the main part of the work, consisting of 210 pages illustrated by 29 full-page plates and 72 text figures. Although, with the exception of birds, all classes of vertebrates are represented by species having degenerate eyes, by far the greatest number is found in fishes and fish-like vertebrates.

Only two species of mammals are described —the common mole and the cave rat. The former has very degenerate eyes, while in the latter the eyes are practically normal and resemble very closely those of the common gray rat.

Of the amphibians only four species of salamanders are described as inhabiting caves. Three are from the caves of the Mississippi valley, the fourth is from the underground streams near San Marcos, Texas. Detailed descriptions of these eyes are given.

Three reptiles are described: *Amphisbæna punctata,* a blind legless lizard from Cuba; *Rhineura floridana,* a legless burrowing lizard from Florida; and *Typhlops lumbricalis,* a blind snake found generally distributed in the West Indies and Guiana.

After a brief description of the eye of a fish (*Zygonectes notatus*) having normal vision and closely related to the blind fishes, he begins a detailed description of the different species of blind fishes. Although special reference is given to the eye, he treats of such general topics as general habits, respiration, reactions to light, tactile organs, the ear, anatomy of different organs, reproduction, etc.

He describes the development of *Amblyopsis* from the egg, being successful in rearing one to the age of ten months. He corrects the erroneous idea that *Amblyopsis* is viviparous. The mother deposits the eggs in the gill clefts, where they are retained during development till the young reach a length of about 10 mm. and the yolk is mostly absorbed.

Tactile organs are extremely well developed and these take the place of the lost visual sense. The ear is normal. In regard to their power of hearing, he says:

. . . if we define hearing to be the sensation

received through the ear and caused by vibrations either in the air or water, the experiments cited do not enable one to conclude definitely whether the blind fishes hear or not. If they do hear, their power in this direction is very limited.

Twelve species of blind fishes are dealt with. One, *Typhlogobius californiensis,* found under the rocks at Point Loma, near San Diego, Cal., has normal eyes when young, but degenerate in the adult. Another, a blind catfish (*Amieurus nigrilabris*) from Pennsylvania, is briefly described by Cope. The remaining ten species of blind fishes were procured from the caves of central and southwestern United States and from Cuba. Eight of these belonging to the Amblyopsidæ ("blind fishes") inhabit North America. The other two, members of the Brotulidæ, were secured in the caves of Cuba.

Of the Amblyopsidæ three species of *Chologaster* (*cornutus, papalliferus* and *agassizii*) have well-developed eyes. The other species of Amblyopsidæ, *Amblyopsis spelæus, Troglichthys rosæ, Typhlichthys subterraneus, Typhlichthys osborni* and *Typhlichthys wyandotte,* have only vestigial eyes.

The two Cuban species, *Stygicola* and *Lucifuga,* were both found to be viviparous. No definite breeding season could be determined, as females with young were found at various times throughout the year. "The eye decreases in size progressively from birth to extreme old age concomitantly with the appearance of masses of pigment cells in the orbital fat." Shriveling may occur in one eye of an individual while the other may show a massing of pigment cells. All structures connected with the eye show this progressive reduction from birth to old age.

The closing chapter discusses the causes of individual and phyletic degeneration. The following views of others concerning the cause of degeneration are discussed: (1) Organs diminish with disuse (Lamarck, Roux, Packard); (2) through a condition of panmixia a reduction occurs (Romanes, Lankester, Morgan, Weismann); (3) natural selection (Darwin, Romanes); (4) struggle of organs for room and food (Roux, St. Hilair); (5) the struggle between soma and germ for greatest efficiency at least expense (Lendenfeld); (6) germinal selection (Weismann), (7) process of mutation.

The author's views of the causes of degeneration may best be given in his own words:

The Lamarckian view, that through disuse the organ is diminished during the life of the individual, in part at least on account of the diminution of the amount of blood going to a resting organ, and that this effect is transmitted to succeeding generations, not only would theoretically account for unlimited progressive degeneration, but is the only view so far examined that does not in the face of it present serious objection. Is this theory applicable in detail to the conditions found in the Amblyopsidæ? Before going farther, objections may be raised against the universal assumption that the cessation of use and the consequent panmixia was a sudden process. This assumes that the caves were peopled by a catastrophe. But it is absolutely certain that the caves were not so peopled, that the cessation of use was gradual and the cessation of selection must also have been a gradual process. There must have been ever widening bounds within which the variation of the eye would not subject the possessor to elimination.

*Chologaster* is in a stage of panmixia as far as the eye is concerned. It is true the eye is still functional, but that the fish can do without its use is evident by its general habit and by the fact that it sometimes lives in caves.

The present conditions have apparently existed for many generations, as long as the present habits have existed, and yet the eye still maintains a higher degree of structure than reversed selection, if operative, would lead us to expect, and a lower degree than the birth mean of fishes depending on their eyes—the condition that the state of panmixia alone would lead us to expect. There is a staying quality about the eye with the degeneration, and this can only be explained by the degree of use to which the eye is subjected.

Three general conclusions may be added:

(1) The bleached condition of animals living in the dark, and individual environmental adaptation, is transmissible and finally becomes hereditarily fixed. (2) Ornamental secondary sexual characters not being found in blind fishes are, when present, probably due to visual selection. (3) Individual degeneration of the eye may begin in even earlier stages of development until nearly

the entire development becomes affected, that is, functional adaptations are transmissible.

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*Effects of the Rays of Radium on Plants.* By Charles Stuart Gager. Memoirs of the New York Botanical Garden, Vol. IV., 1908. Imp. 8vo, viii + 278 pages, 73 figures and 14 plates. Price $2.00.

As known to several botanists, the author was engaged for some time in studying the effects of radioactivity on various plant processes. The present volume represents the sum and substance of approximately four years of labor and is presented as a pioneer investigation; comprehensive in scope and as offering initial suggestions for several important problems.

During the research period "standard preparations of the purest radium bromid yet obtained" were placed at the disposal of Dr. Gager by Mr. Hugo Lieber, of New York City. As a result of the cooperation of liberality and investigation we may now feel quite certain that the rays of radium constitute a stimulus to the metabolic processes in plants. In conformity with other stimuli, that of radioactivity exhibits a minimum, optimum and maximum. Metabolic processes in general, whether constructive or destructive, are accelerated by intensities of stimulation between the minimum and optimum, while greater intensities beyond the optimum retard until death follows at the maximum.

Looking more particularly at the individual topics treated, we find an initial chapter of fourteen pages which constitutes a digest of about one hundred and fifty citations. In clear and rather popular style the essential facts of the nature of radioactivity are presented.

The universal presence of radioactivity in soil, water, rain, snow, etc., is elaborately discussed and the obvious deduction drawn that living matter can hardly escape its influence. Such being the case, any sudden change in the intensity of the emanations would be expected to constitute a stimulus to the exposed organisms.

Quite appropriately some attention is given to the undemonstrated conclusions of various authors regarding radioactivity as a property of wood, flowers and other plant organs. The unsuccessful efforts to artificially create life through the influence of radium are explained. An historical review of previous work done on both plants and animals occupies several pages.

The power of radium to affect the germination of seeds and the subsequent growth of the seedlings is clearly shown by the author's own work. A given plant can be educated, so to speak, to endure an intensity of stimulus which on first exposure retarded growth. This shows that since radioactivity is so universal in nature that plants are probably naturally attuned to at least a low intensity which may be gradually increased without disturbing the normal processes in the plant. Freshly fallen rain may have sufficient radioactivity to retard growth of plant organs. The same may be true of tap-water previously exposed to the emanations of radium.

Alcoholic fermentation, and respiration, both aerobic and anaerobic, were found to respond to stimulus. On the other hand, tropistic responses were not with certainty demonstrated.

The profound influence of the rays of radium is manifest if we look at the abnormalities arising in the cells and tissues of plants exposed. Thus in the hypocotyls of beans, lupins, etc., retardation of growth was accompanied by a lack of coordination in histogenesis, stoppage of cell-division, acceleration of tissue-differentiation, decrease in size of the cells. In a given case any one or all of those effects may be found. Mitosis in any of its phases is likely to be profoundly modified with marked distortion of the mitotic figures and disturbance of the normal processes of nuclear division.

The attempts to induce mutation by radioactivity were not continued to success, though some intimations were obtained that it may be possible to do so.

The paper closes with an extended theoretical discussion of about seventeen pages.

From the facts included in this descriptive review it is evident that this work has a com-